Docket No.: 21333/0209040-US0
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Letters Patent of:
Nishit Kumar

Patent No.: 7,372,873

Issued: May 13, 2008

For: RECONSTRUCTING A PARTIAL TRANSPORT STREAM

REQUEST FOR CERTIFICATE OF CORRECTION
PURSUANT TO 37 CFR 1.323 AND 1.322

Attention: Certificate of Correction Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Upon reviewing the above-identified patent, Patentee noted typographical errors which should be corrected. A listing of the errors to be corrected is attached.

The typographical errors marked with an "A" on the attached list are found in the application as filed by applicant. Please charge our Credit Card in the amount of $100.00 covering the fee set forth in 37 CFR 1.20(a).

The typographical errors marked with a "P" on the attached list are not in the application as filed by applicant. Also given on the attached list are the documents from the file history of the subject patent where the correct data can be found.

The errors now sought to be corrected are inadvertent typographical errors the correction of which does not involve new matter or require reexamination.

Transmitted herewith is a proposed Certificate of Correction effecting such corrections. Patentee respectfully solicits the granting of the requested Certificate of Correction.

The Commissioner is authorized to charge any deficiency of up to $300.00 or credit any excess in this fee to Deposit Account No. 04-0100.

Dated: July 8, 2008

Respectfully submitted,

By _____

Flynn Barrison
Registration No.: 53,970
DARBY & DARBY P.C.
P.O. Box 770
Church Street Station
New York, New York 10008-0770
(212) 527-7700
(212) 527-7701 (Fax)
Attorneys/Agents For Applicant

PTO/SB/44 (09-07)
Approved for use through 08/31/2010. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 7,372,873

APPLICATION NO.: 10/608,310

ISSUE DATE : May 13, 2008

INVENTOR(S) : Kumar et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On Sheet 6 of 10, Reference Numeral 561, Fig. 5, line 1, delete "Receve" and insert - - Receive - -, therefor.

In column 1, line 63, after "information" insert - - . - -.

In column 13, line 56, in Claim 7, after "extract" delete "the".

In column 16, line 47, in Claim 36, delete "claim 25," and insert - - claim 35, - -, therefor.

In column 16, line 54, in Claim 38, delete "doable" and insert - - double - -, therefor.

MAILING ADDRESS OF SENDER (Please do not use customer number below):
John W. Branch, Esq.
DARBY & DARBY P.C.
P.O. Box 770
Church Street Station
New York, New York 10008-0770

DARBY & DARBY

Issued Patent Proofing Form File#: **21333/0209040-US0**

Note: **P** = USPTO Error **A** = Applicant Error

US Serial No.: **10/608,310** US Patent No.: **US 7,372,873 B1** Issue Date: **May 13, 2008**

Title: **RECONSTRUCTING A PARTIAL TRANSPORT STREAM**

S. No.	P/A	Original		Issued Patent		Description of Error
		Page	Line	Column	Line	
1	A	Sheet 6 of 10 Drawings-only black and white line drawings (06/27/2003)	1 (Referral Numeral 561) (Figure 5)	Sheet 6 of 10 (Referral Numeral 561) (Figure 5)	1	Delete "Receve" and insert - - Receive - -, therefor.
2	A	Page 3 Specification (06/27/2003)	18	1	63	After "information" insert - - . - -.
3*	A	Page 3 of 12 Claims (01/16/2008)	Claim 7 Line 3	13	56	In Claim 7, after "extract" delete "the".
4	P	Page 10 of 12 Claims (01/16/2008)	Claim 38 Line 1	16	47 (Approx.)	In Claim 36, delete "claim 25," and insert - - claim 35, - -, therefor.
5	P	Page 10 of 12 Claims (01/16/2008)	Claim 40 Line 2	16	54	In Claim 38, delete "doable" and insert - - double - -, therefor.

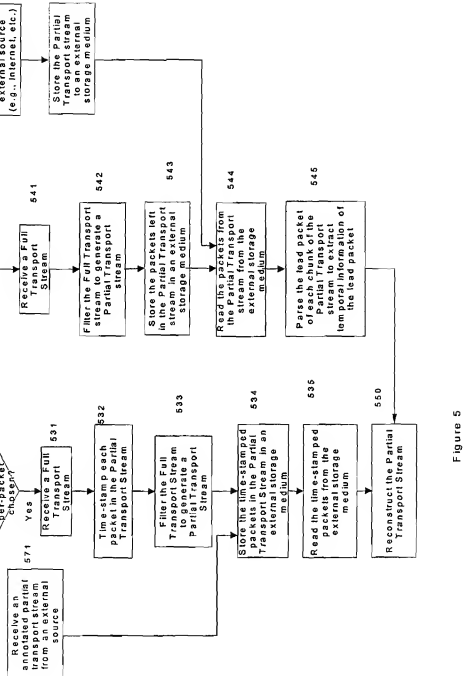
Receive a signal
510
Is time-stamp per-packet chosen?
520
No
Yes
Receive a Full Transport Stream
531
Time-stamp each packet in the Partial Transport Stream
532
Filter the Full Transport Stream to generate a Partial Transport Stream
533
Store the time-stamped packets in the Partial Transport Stream in an external storage medium
534
Read the time-stamped packets from the external storage medium
535
Reconstruct the Partial Transport Stream
550
Receive an annotated partial transport stream from an external source
571
Receive a Full Transport Stream
541
Filter the Full Transport stream to generate a Partial Transport Stream
542
Store the packets left in the Full Transport Stream in an external storage medium
543
Read the packets from the Partial Transport stream from the external storage medium
544
Parse the head packet of each chunk of the Partial Transport Stream to extract information on the size of the head packet
545
Receive a Partial Transport stream from an external source (e.g., internet, etc.)
561
Store the Partial Transport stream in an external storage medium
562

Figure 5

RECONSTRUCTING A PARTIAL TRANSPORT STREAM

FIELD OF INVENTION

The present invention relates to digital video processing, and more particularly, to reconstructing a partial transport stream in a digital television system.

BACKGROUND

Digital video is being used in an increasing array of applications ranging from personal computers (PC) and video conferencing to digital televisions (TV), set-top boxes, and personal video recorders (PVR). These varied video systems can process content from cable, satellite, and terrestrial broadcasts as well as streaming video and video-on-demand over the internet. The digital television industry faces several challenges in order to accelerate worldwide deployment of these technologies. It needs to make TV compelling and engaging, lower the cost of the roll-out of interactive services on digital TV, and develop a whole range of products in cost effective ways to take advantage of new market opportunities.

In particular, the fast-growing PVR systems (also known as Digital Video Recorders DVR) allow consumers to interactively choose which content they want to watch, from broadcast media or video-on-demand, and when to watch it. The viewers have the control, management rights, and personalization options on digital content. For example, the PVR/DVR systems allow viewers to record TV broadcasts from cable, satellite, or over-the-air to a hard disk. These systems record automatically, allowing viewers to pause, rewind, and replay live television. Furthermore, the PVR/DVR systems allow easy management of pre-recorded programs, and the ability to schedule and specify the recordings.

An important component of a PVR/DVR system is the storage medium. Traditionally, hard disks have been used as the storage medium. Newer systems have also employed conventional VHS tapes to record digital content in a compressed format, for example, the Digital VHS (D-VHS) format. These systems interface with digital video processing integrated circuits (ICs) using the IEEE 1394 digital interface. The format of digital content stored can range from full transport streams to partial transport streams and program streams.

Full transport streams contain fixed-size packets from several different compressed programs interleaved together. For example, broadcast signals use full transport streams. These carry not only the content information within the packets, but also the temporal information, which is important for maintaining precise display rates in a television receiver. On the other hand partial transport streams contain only a selected subset of packets, usually filtered based on the packet identifier (PID). From a storage perspective, systems based on partial transport streams are superior to the ones based on full transport. Program streams, used ubiquitously in DVDs, are non-packetized streams of data usually containing only a single compressed program. Systems based on program streams require additional control information to be stored, since the stored content has only limited temporal information.

Since content in a transport-stream based PVR/DVR system could originate from a storage medium (and not a broadcast signal), an important problem is reconstructing the stream precisely. All temporal information must be recreated. For full transport streams, a hardware module can read data from the storage medium at a fixed, known rate and recreate the temporal information. However, the problem is more challenging for partial transport streams. Proper gaps for packets that were dropped due to PID filtering have to be recreated. The transport stream reconstruction problem also arises when a partial transport stream has to be recorded on an ISO-61883 compliant storage medium connected via IEEE 1394 interface. For example, the input to a D-VHS tape must be a partial transport stream with very low jitter so that the content can be played back to the digital TV system as precisely as a broadcast signal.

SUMMARY OF INVENTION

A method and a system for reconstructing partial transport streams are described. One embodiment of the method includes time-stamping each packet when the packet arrives, storing the selected subset of packets and the associated timestamps in a storage medium, reading at playback time the stored packets and their timestamps from the storage medium, and reconstructing the partial transport stream.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description that follows and from the accompanying drawings, which however, should not be taken to limit the appended claims to the specific embodiments shown, but are for explanation and understanding only.

FIG. **1** shows an exemplary embodiment of a hardware unit within a DVR/PVR system.

FIG. **2** shows an embodiment of an encoder/decoder rate synchronizer loop.

FIG. **3**A shows a flow diagram of an embodiment of a process for timestamp-per-packet.

FIG. **3**B shows the logical interconnection of components in one embodiment of timestamp-per-packet.

FIG. **4** shows a flow diagram of an embodiment of a process for timestamp-per-chunk.

FIG. **5** shows a flow diagram of an embodiment of dynamically selecting timestamp-per-packet or timestamp-per-chunk.

FIG. **6**A shows sample partial transport streams.

FIG. **6**B shows an example of packet jitter in an IEEE 1394 device.

FIG. **7** shows an embodiment of a playback unit.

FIG. **8** shows an alternate embodiment of a playback unit.

DETAILED DESCRIPTION

A method and a system for reconstructing partial transport streams are described. One embodiment of the method includes time-stamping each packet when the packet arrives, storing the selected subset of packets and the associated timestamps in an external storage medium, reading at playback time the stored packets and their timestamps from the external storage medium, and reconstructing the partial transport stream. In another embodiment, the method includes receiving a partial transport stream in such a way that there may or may not be an opportunity for time-stamping each packet. The method involves breaking down the partial transport stream into chunks of several packets, parsing the lead packet of each chunk to extract temporal information of the lead packet, and reconstructing the partial transport stream with piece-wise temporal accuracy.

sor does long-term rate control, and alternately programs the playback unit **700** with different transport buffer parameters.

FIG. **8** shows another embodiment of a playback unit **800**. The components of the playback unit **800** can be implemented with hardware (e.g., circuitry, dedicated logic, etc.), software (such as is run on a general purpose computer system or a dedicated machine), or a combination of both. Referring to FIG. **8**, the playback unit **800** includes an interface **810** to read chunks of a partial transport stream from an external storage medium (not shown). Each chunk includes a lead packet. In one embodiment, the lead packet is a PCR packet. The playback unit **800** further includes a parser **820** to parse the lead packet to extract the temporal information of the lead packet. Processing logic **830** reconstructs the partial transport stream with the temporal information and the chunks.

The foregoing discussion merely describes some exemplary embodiments of the present invention. One skilled in the art will readily recognize from such discussion, the accompanying drawings and the claims that various modifications can be made without departing from the spirit and scope of the appended claims. The description is thus to be regarded as illustrative instead of limiting.

What is claimed is:

1. A method comprising:

time-stamping a lead packet in each of a plurality of chunks, each of the plurality of chunks comprising the lead packet and a plurality of packets, the lead packet comprising a program clock reference (PCR) packet and a chunk length of a chunk associated with the lead packet;

storing the time-stamped chunks on a storage medium;

reading back at playback time the stored chunks with their timestamps from the storage medium; and

reconstructing a partial transport stream using the chunks and their timestamps read back, wherein the chunks are arranged in the partial transport stream in response to their timestamps.

2. The method of claim **1**, further comprising:

receiving a full transport stream; and

filtering the full transport stream to generate the subset of time-stamped packets.

3. The method of claim **1**, wherein the storage medium is an external memory.

4. The method of claim **3**, wherein the external memory comprises a double data rate memory (DDR).

5. The method of claim **1**, wherein time-stamping includes recording a value of a counter for the lead packet.

6. The method of claim **5**, wherein the counter is a system time clock counter.

7. A method comprising:

reading a plurality of chunks of a partial transport stream from a storage medium;

parsing a lead packet of each of the plurality of chunks to extract the temporal information of the lead packet, wherein the temporal information includes the chunk length of the chunk associated with the lead packet; and

reconstructing the partial transport stream using the extracted temporal information and the plurality of chunks, wherein the lead packet is placed in the partial transport stream in response to the temporal information.

8. The method of claim **7**, wherein the storage medium is an external memory.

9. The method of claim **8**, wherein the external memory comprises a double data rate memory (DDR).

10. The method of claim **7**, wherein the lead packet is a program clock reference (PCR) packet.

11. The method of claim **7**, wherein the temporal information includes the release time of the lead packet.

12. A method comprising:

detecting a signal;

dynamically selecting a first or a second modes in response to the signal, wherein the first mode includes

time-stamping each of a plurality of packets,

storing a subset of the time-stamped packets on a storage medium,

reading at playback time the stored packets from the storage medium, and

reconstructing a first partial transport stream using the timestamps of the plurality of packets, wherein the plurality of packets are arranged in the first partial transport stream in response to the timestamps; and

wherein the second mode includes

reading a plurality of chunks of a second partial transport stream from the storage medium,

parsing a lead packet of each of the plurality of chunks to extract the temporal information of the lead packet within the second partial transport stream, wherein the temporal information includes the chunk length of the chunk associated with the lead packet, and

reconstructing the second partial transport stream using the extracted temporal information and the plurality of chunks, wherein the lead packet is placed in the second partial transport stream in response to the temporal information.

13. The method of claim **12**, wherein the storage medium is an external memory.

14. The method of claim **13**, wherein the external memory includes a double data rate memory (DDR).

15. A method comprising:

receiving an annotated partial transport stream from an external source;

storing a plurality of time-stamped chunks from the partial transport stream on a storage medium;

reading back at playback time the stored time-stamped chunks from the storage medium; and

reconstructing the partial transport stream using temporal information extracted from the plurality of time-stamped chunks, the plurality of time-stamped chunks being arranged in response to their timestamps, said temporal information including chunk lengths of the plurality of time-stamped chunks.

16. The method of claim **15**, wherein the storage medium is an external memory.

17. The method of claim **16**, wherein the external memory includes a double data rate memory (DDR).

18. A system comprising:

a storage medium;

a transport proccssor coupled to the storage medium, wherein the transport processor time-stamps each of a plurality of chunks received and to store the plurality of chunks on the storage medium; and

a playback device coupled to the storage medium, wherein the playback device reads back the stored chunks from the storage medium and to reconstruct at playback time a partial transport stream with the chunks read back, a chunk length extracted from a lead packet of each of the plurality of chunks, and the timestamps of the chunks read back.

19. The system of claim **18**, wherein the storage medium includes an external memory.

20. The system of claim 19, wherein the external memory includes a double data rate memory (DDR).

21. The system of claim 18, wherein the transport processor comprises a filter to turn an incoming full transport stream into a partial transport stream, the partial transport stream includes the one or more of the plurality of packets.

22. The system of claim 21, wherein the transport processor further comprises a system time clock (STC) counter to record the time when each of the plurality of packets is received.

23. A system comprising:

a storage medium; and

a playback device coupled to the storage medium, the playback device including

an interface to read a plurality of chunks of a partial transport stream from the storage medium, each of the plurality of chunks including a lead packet,

a parser to parse the lead packet to extract temporal information of the partial transport stream, wherein the temporal information includes the chunk length of the chunk associated with the lead packet, and

a processing logic module to reconstruct the partial transport stream with the temporal information and the plurality of chunks.

24. The system of claim 23, wherein the storage medium includes an external memory.

25. The system of claim 24, wherein the external memory includes a double data rate memory (DDR).

26. The system of claim 23, wherein the lead packet is a program clock reference (PCR) packet.

27. The system of claim 23, wherein the temporal information includes the release time of the lead packet of each of the plurality of chunks.

28. A system comprising:

a storage medium;

a playback device coupled to the memory;

a processor coupled to the storage medium, wherein the processor receives a signal and to dynamically select a first mode or a second mode in response to the signal,

wherein the first mode comprises

time-stamping each of a plurality of packets,

storing a subset of the time-stamped packets on the storage medium,

reading at playback time the stored packets from the storage medium, and

reconstructing a first partial transport stream with the packets read; and

wherein the second mode comprises

reading a plurality of chunks of a second partial transport stream from the storage medium, each of the plurality of chunks including a lead packet,

parsing a lead packet of each of the plurality of chunks to extract the temporal information of the lead packet in the second partial transport stream, wherein the temporal information includes the chunk length of the chunk associated with the lead packet, and

reconstructing the second partial transport stream with the temporal information of the lead packets and the plurality of chunks.

29. The system of claim 28, wherein the storage medium includes an external memory.

30. The system of claim 29, wherein the external memory includes a double data rate memory (DDR).

31. The system of claim 29, wherein the external memory includes a hard disk.

32. A method comprising:

in response to a signal, dynamically selecting a timestamp-per-packet mode or a timestamp-per-chunk mode to reconstruct a video stream, and

if the timestamp-per-chunk mode is selected,

reading a plurality of chunks from a storage device, each of the plurality of chunks comprising a lead packet and a plurality of packets;

parsing a lead packet of each of the plurality of chunks to extract temporal information and a chunk length of a respective chunk from the lead packet; and

reconstructing the video stream using the plurality of chunks, the temporal information, and the chunk length.

33. The method of claim 32, wherein reconstructing the video stream comprises:

placing the lead packet in the video stream according to the temporal information.

34. The method of claim 32, wherein the lead packet is a program clock reference (PCR) packet.

35. A system comprising:

a storage medium;

a processor coupled to the storage medium, wherein the processor dynamically selects a timestamp-per-packet mode or a timestamp-per-chunk mode to reconstruct a video stream, wherein, if the timestamp-per-chunk mode is selected, the processor retrieves a plurality of chunks from the storage device, each of the plurality of chunks including a lead packet and a plurality of packets, the processor further parses the lead packet of each of the plurality of chunks to extract temporal information and a chunk length of a respective chunk, and to reconstruct a video stream using the plurality of chunks, the temporal information, and the chunk length.

36. The system of claim 25, further comprising:

a playback device coupled to the processor to play the video stream reconstructed.

37. The system of claim 28, wherein the storage medium includes an external memory.

38. The system of claim 29, wherein the external memory includes a doable data rate memory (DDR).

* * * * *